

**Window Technology**

for

**Habitat for Humanity**

**White County Arkansas Affiliate**

by

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**Abstract:**

Windows are responsible for a significant amount of the energy cost of a house. They allow unwanted hot or cold air to enter the house, which increases the cost of keeping the temperature of the house consistent. Because of this, the available window technologies were investigated for the White County affiliate of Habitat for Humanity (HfH) to determine the most cost efficient window design for builds in White County. The cost of electricity for annual heating and cooling was used to determine the benefits of different technologies specific to Searcy’s conditions. Due to the location in the South-Central Region, the key factors in window selection are a U-Value that is less than or equal to 0.30 and a Solar Heat Gain Coefficient (SHGC) of approximately 0.30. A coating such as a Low-E coating is often essential in achieving these ratings. ThermaStar windows by Pella have been used in the past for White County builds. It was suggested by Doug Rye that all windows be purchased from contractors rather than department stores to ensure quality that will last throughout the lifetime of the house. A contractor, Harry G. Barr of Weather-barr in Ft. Smith, was located.

**Introduction:**

The purpose of this report is to determine the pertinent features for window selection and the important considerations for the design and placement of windows in future HfH builds. Window technologies with the most impact on cost and efficiency are glazing, frame type, opening mechanism, coating, and the type of gas filling. Other considerations include the build site’s climate, orientation of the windows in regards to the house and absolute direction, the size of the window, the shading conditions, and the quality of their installation.

**Objectives/Specifications:**

The objective of this project was to determine the most cost effective and energy efficient window choice for future HfH builds.

**Conceptual Designs/Alternatives:**

Due to changing product availability, a general guideline was determined instead of a specific product choice. Using the cost of electrical air conditioning and heating for Searcy in 2010 (0.0757 $/kWh), the total cost of several different windows over a twenty year time period was calculated. Seven 3’x5’ windows were assumed to keep the size consistent (actual bedroom egress requirement is at least 5.7 sq. ft. with a minimum 20 in. width and 24 in. height), and a 1050 square foot house is assumed to be consistent with HfH guidelines. The data from the University of Minnesota’s Efficient Windows Collaborative website was used and adapted for HfH specifications.

The overall energy cost of the window was considered and different U-Value and SHGC combinations were included to determine the most efficient region specific choice. Two different Solar Heat Gain Coefficients were considered using the data for Searcy, AR.

The orientation of the windows was also considered. Calculations and comparisons were done considering different concentrations of the percentage of wall space used for windows on a particular side of the house. Fading capability for each side was also considered.

**Findings:**

Window related energy costs decrease as rated U-Value decreases. Energy costs decrease as SHGC values increase. However, the combined impact of the U-Value and SHGC was much greater than a change in value of a single energy rating. Figure 1, below, shows the increase in the cost per U-Value and illustrates the effect of two different SHGCs on the price.

*Figure 1*

*Figure 2*

As illustrated in Figure 2, above, implementing a vinyl frame vs. an aluminum frame will decrease window energy costs up to $2,000 per window over the life-span of the house. The number of glazes affects the energy costs as well. In order to achieve their energy ratings coatings or glazes are applied to the glass of the windows. A double glazed window will decrease the life time window energy costs by approximately $200 per window per year. A triple glazed window can decrease energy costs by an additional $40 annually; however, the third layer significantly decreases the visible light allowed to pass through the window which decreases the available light in the house.

For the opening mechanism, the single hung was found to be the least expensive and, due to the fewer hinge points which allow air leakage, more efficient than both double hung and sliding windows. The addition of grids for aesthetic appeal was found to increase the initial cost and also decrease the efficiency.

When the orientation of the windows throughout the house was examined, it was found that windows on the East and West sides of the house can cause an increase in energy costs from windows. This is a result of the higher solar heat that they are exposed to, especially during the summer months, which can increase the air conditioning costs and also encourage fading of the furniture. South facing windows are also responsible for a significant amount of unwanted solar heat gain throughout the summer but this can be avoided with the use of shade such as an overhang. A lower SHGC, which is not ideal for Searcy, AR, will minimize any effect of orientation. Also, the fading effect can be significantly decreased by a Low-E coating, so that the effects of orientation will be negligible. Table 1, below, shows the approximate energy cost for each window orientation concentration.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| U-Value | SHGC | Equal | North | East | South | West |
| 0.41-0.55 | 0.41-0.60 | 555 | 567 | 555 | 516 | 575 |
| 0.31-0.40 | 0.41-0.60 | 501 | 516 | 501 | 469 | 524 |
| 0.31-0.40 | ≤0.25 | 508 | 516 | 508 | 501 | 520 |
| ≤0.20 | ≤0.25 | 438 | 446 | 438 | 418 | 450 |

*Table 1*

Several available products were compared using the assumptions mentioned above. Figure 3 shows that paying the initial cost of an appropriate U-Value and/or SHGC can significantly decrease the energy costs related to the windows over the twenty year life span of the house.

*Figure 3*

Doug Rye of the Doug Rye radio show, based in Little Rock, AR, has been helping homeowners improve the efficiency of their homes for nearly thirty years. He was contacted and was able to offer some advice regarding window selection. He explained that in his experience at least, the department store windows are of poor quality and quickly deteriorate below their marketed energy ratings. He recommended Harry G. Barr in the Fort Smith area as a window contractor to work with.

**Conclusions:**

The key factors in window selection are a U-Value less than or equal to 0.30 and a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.30. A Low-E coating is recommended as it helps to achieve these values as well as decreased fading. A vinyl framed, single hung window with two layers of glaze will decrease the total lifetime cost for the homeowner. Orientation will not have a severe impact on the energy cost if recommended energy values are implemented. It is recommended that windows be purchased outside of a department store for quality.

**References:**

[www.efficientwindows.org](http://www.efficientwindows.org)

Doug Rye – [www.DougRye.com](http://www.DougRye.com)